

# NAVAL POSTGRADUATE SCHOOL

## Monterey, California



### THESIS

**COST AND BENEFIT ANALYSIS OF ALTERNATIVES TO  
THE NAVAL RESERVE OFFICER TRAINING CORPS  
FLIGHT PHYSICAL SCREENING PROCESS**

by

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September 2000

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This thesis determined the optimal pre-commissioning flight physical site for every NROTC unit and used derived attrition information to estimate the cost of the current screening system, as well as the two selected alternatives. Further, all three screening options were compared against each other utilizing a cost-benefit analysis.

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RESERVE OFFICER TRAINING CORPS (NROTC) FLIGHT PHYSICAL  
SCREENING PROCESS**

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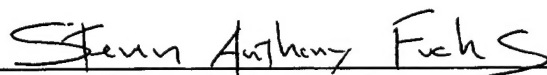
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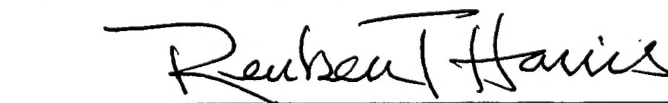
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## **ABSTRACT**

Questions have arisen concerning the efficiency of the Naval Reserve Officer Training Corps (NROTC) flight physical screening process. This study analyzed two alternative means to aeronautically assess these individuals: restructuring the pre-commissioning flight physical and opening the Aviation Certification Evaluation and Screening (ACES) program to all NROTC aviation candidates. A detailed description of the current NROTC aviation screening system, quantification and analysis of flight physical attrition rates, and recommendations for streamlining the overall process are also provided.

This thesis determined the optimal pre-commissioning flight physical site for every NROTC unit and used derived attrition information to estimate the cost of the current screening system, as well as the two selected alternatives. Further, all three screening options were compared against each other utilizing a cost-benefit analysis.



## TABLE OF CONTENTS

I.	INTRODUCTION.....	1
A.	BACKGROUND.....	1
B.	PURPOSE.....	2
C.	SCOPE.....	2
D.	RESEARCH QUESTIONS.....	2
1.	Primary Research Question.....	2
2.	Secondary Research Questions.....	3
E.	METHODOLOGY.....	3
F.	ORGANIZATION OF STUDY.....	3
II.	AN OVERVIEW OF THE NAVAL OPERATIONAL MEDICAL INSTITUTE.....	5
A.	COMMAND HISTORY.....	5
B.	MISSION AND RESPONSIBILITIES.....	6
C.	NROTC AVIATION SCREENING PROCESS.....	7
III.	ATTRITION ANALYSIS OF THE NROTC AVIATION SCREENING PROCESS.....	11
A.	OVERVIEW.....	11
B.	PROBLEMS ASSOCIATED WITH THE NROTC SCREENING PROCESS.....	11
C.	ATTRITION LEVELS QUANTIFIED.....	14
1.	The NROTC Flight Physical Process.....	14
2.	Analysis of Attrition Percentages.....	16
3.	The Flight School Attrition Rate.....	17
D.	THE ACES PROGRAM.....	17
IV.	COST-BENEFIT ANALYSIS OF ALTERNATIVES TO THE NROTC AVIATION SCREENING PROCESS.....	21
A.	OVERVIEW.....	21
B.	COST-BENEFIT ANALYSES.....	21
C.	INTRODUCTION TO ALTERNATIVES ANALYZED.....	22

D.	ALTERNATIVE ONE: RESTRUCTURING THE PRE-COMMISSIONING FLIGHT PHYSICAL.....	23
1.	Description.....	23
2.	Methodology.....	23
3.	Creating a Distance Matrix.....	24
4.	The Optimal Pre-commissioning Flight Physical Structure.....	27
a.	Introduction to GAMS.....	27
b.	Structure of the Formulated GAMS Model.....	27
c.	Restructuring Cost Data Quantified.....	28
d.	Modeling Assumptions and Costing Techniques.....	31
e.	The Optimal Pre-commissioning Flight Physical structure.....	32
E.	ALTERNATIVE TWO: OPENING THE ACES PROGRAM TO NROTC AVIATION CANDIDATES.....	36
1.	Description.....	36
2.	Methodology and Assumptions.....	42
3.	NROTC ACES Variable Costs.....	42
4.	Total NROTC ACES Costs.....	43
F.	ALTERNATIVE THREE: IMPLEMENTING NO CHANGE TO THE CURRENT SCREENING SYSTEM.....	45
1.	Description.....	45
2.	Explanation of Changing Flight School Orders.....	45
3.	Relevant Moving Rules and Regulations.....	46
4.	Modeling Assumptions and costing Techniques.....	47
5.	Total Moving Expenses due to Attrition.....	48
6.	Potential Savings.....	49
G.	SENSITIVITY ANALYSIS.....	51
1.	Description.....	51
2.	Analysis.....	51
H.	SUMMARY.....	53
V.	CONCLUSION AND RECOMMENDATIONS.....	55

A.	CONCLUSION.....	55
B.	RECOMMENDATIONS.....	56
C.	RECOMMENDATIONS FOR FURTHER STUDY.....	58
	LIST OF REFERENCES.....	59
	INITIAL DISTRIBUTION LIST.....	61



## LIST OF TABLES

Table 3.1.	Stand-Alone and Consortium NROTC Units.....	12
Table 3.2.	Most common Disqualifying Eye Conditions.....	14
Table 3.3.	Pre-Commissioning Flight Physical Attrition Rates.....	15
Table 3.4.	Year to Date Results of the ACES Program.....	18
Table 3.5.	Contents of the ACES Program.....	19
Table 4.1.	Flight Surgeon Locations Considered by Alternative One.....	25
Table 4.2.	NROTC Unit / Flight Surgeon Location Distance Matrix.....	26
Table 4.3.	Historical Per Diem Costs Associated with Flight Surgeon Locations. . . .	29
Table 4.4.	Yearly NROTC Unit Aviator Production Numbers.....	30
Table 4.5.	Traveling Cost Values Imputed into GAMS.....	33
Table 4.6.	GAMS NROTC Pre-Commissioning Flight Physical Assignments.....	34
Table 4.7.	Total Cost vs. the Number of Flight Surgeon Locations Used.....	35
Table 4.8.	Actual Restructuring Costs by Year.....	35
Table 4.9.	Alternative One's Time-Valued Costs.....	36
Table 4.10.	FY 95 Pre-Commissioning Flight Physical Travel Costs.....	37
Table 4.11.	FY 96 Pre-Commissioning Flight Physical Travel Costs.....	38
Table 4.12.	FY 97 Pre-Commissioning Flight Physical Travel Costs.....	39
Table 4.13.	FY 98 Pre-Commissioning Flight Physical Travel Costs.....	40
Table 4.14.	FY 99 Pre-Commissioning Flight Physical Travel Costs.....	41
Table 4.15.	Cost Breakdown of the ACES Program.....	44
Table 4.16.	Alternative Two's Time-Valued Costs.....	43
Table 4.17.	Authorized Travel Days.....	47
Table 4.18.	Alternative Three's Time-Valued Costs (Moving 2,000 lbs).....	48
Table 4.19.	Moving Costs Resulting From Attrition (2,000 lbs).....	49
Table 4.20.	Alternative Three's Time-Valued Costs (Moving 600 lbs).....	49
Table 4.21.	Moving Costs Resulting From Attrition (600 lbs).....	49
Table 4.22.	Average Cost of Moving 2,000 lbs to Newport.....	50
Table 4.23.	Time-Valued cost of Moving NPQ Candidates Directly to Newport.....	50
Table 4.24.	Time-Valued Costs Assuming a \$300 Airline Ticket.....	52
Table 4.25.	Time-Valued Costs Assuming a 2/3 Reduction in TAD Reimbursable Rates.....	52
Table 4.26.	Time-Valued Costs Assuming a \$300 Airline Ticket and 2/3 TAD Charges.....	53





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## **I. INTRODUCTION**

### **A. BACKGROUND**

The Department of the Navy entity responsible for determining if aviation candidates are physically qualified to serve as a pilot or flight officer is the Naval Operational Medical Institute (NOMI). The specific office within NOMI that makes these determinations is Code 26, Physical Evaluations.

To NOMI's credit, the end result of their aviation medical screening process is accurate; however, questions have arisen regarding its efficiency. Perhaps the major apprehension is that the current system can become very expensive when there are discrepancies between pre-commissioning and NOMI flight physical results. Often enough to cause concern, a potential aviator will pass the pre-commissioning physical, report to Pensacola, and be found not physically qualified by NOMI. This creates a large—wasteful—personnel-relocation expense for the Navy; in addition to the relocating costs, the salaries of the transitioning officers should also be considered an expense.

Ensigns reporting to flight school earn their commissions from one of three communities: just under 40% come from the United States Naval Academy (USNA), just over 40% come from the Naval Reserve Officer Training Corps (NROTC), and roughly 20% are commissioned through Officer Candidate School (OCS) [[navaltx.navy.mil/cnatra/programs.htm](http://navaltx.navy.mil/cnatra/programs.htm)]. According to several individuals within NOMI, ensigns commissioned through the NROTC program pose the greatest burden on the screening system. The objective of this thesis is, therefore, to ascertain means through which the NROTC aviation screening process can be made more cost-effective.

## **B. PURPOSE**

This thesis critically assesses the costs associated with screening NROTC aviation candidates. Secondly, the study presents alternative options available to NOMI to screen these individuals. The study then identifies the costs and benefits associated with implementing these options.

## **C. SCOPE**

This thesis will provide recommendations for increasing the efficiency of the initial Naval aviation medical screening process. It presents a cost-benefit analysis of alternative means to conduct pre-commissioning flight physicals for NROTC midshipmen and officer candidates. Analyzing the screening of aviation candidates from the United States Naval Academy and OCS was deliberately excluded from this study; these officer programs were excluded because of their centralized structure. The NROTC program, on the other hand, doesn't have a centralized structure. Candidates from this program come from one of fifty-seven units at colleges across the United States, completing their pre-commissioning physicals at approximately 150 different facilities (CAPT Deakins, 31 MAY 00 email). Because of the numerous facilities used for the pre-commissioning physicals, a standardized level of quality (pertaining to the flight physical) has been extremely hard to maintain and follow—producing questionable discrepancies between pre-commissioning and NOMI flight physical results.

## **D. RESEARCH QUESTIONS**

### **1. Primary Research Question**

How much does the inefficiency of NOMI's NROTC aviation medical screening process cost and how might this process be improved?

## **2. Secondary Research Questions**

- a. How does NOMI currently screen NROTC midshipmen for entrance into the Naval aviation community?
- b. How frequently is an individual that passed their pre-commissioning flight physical found not physically qualified for aviation service by NOMI?
- c. Considering the DoN's infrastructure, what medical facilities have flight surgeons capable of giving a pre-commissioning flight physical?
- d. What would be the costs and benefits of changing NOMI's current screening system?

## **E. METHODOLOGY**

This thesis will mainly evaluate the primary mission of NOMI's Code 26 Office, as it pertains to screening NROTC aviation candidates. The information needed to conduct this study will be drawn from correspondence with individuals within NOMI's command, and a literary search of texts, magazines, publications, and all other library resources relevant to the topic. After understanding NOMI's mission, objectives, and screening process, attrition rates between the pre-commissioning and NOMI physicals will be determined; these rates will be calculated as follows:

1. Identifying how many NROTC candidates pass the pre-commissioning physical and are sent to Pensacola, FL for flight training.
2. Identifying how many NROTC commissioned ensigns are found not physically qualified for aviation at the NOMI flight physical.

Lastly, alternatives to the current system will be formulated (with their costs determined) and a cost-benefit analysis will be constructed to compare these alternatives.

## **F. ORGANIZATION OF STUDY**

The reader has now been introduced to the background of the subject matter this thesis addresses, the purpose and scope of this study, the primary and secondary

questions to be answered, and the methodology followed throughout the thesis. The study will be organized as the outline below illustrates.

- I. Introduction
- II. An Overview of the Naval Operational Medical Institute
- III. Attrition Analysis of the NROTC Aviation Screening Process
- IV. Cost-benefit Analysis of Alternatives to the NROTC Aviation Screening Process
- V. Conclusion and Recommendations

## **II. AN OVERVIEW OF THE NAVAL OPERATIONAL MEDICAL INSTITUTE**

### **A. COMMAND HISTORY**

The command history presented below is intended to clarify the meaning, name, and purpose of the Naval Operational Medical Institute as it transitioned through the years; the information was obtained from NOMI's website [[www.nomi.navy.mil/comhist.htm](http://www.nomi.navy.mil/comhist.htm)].

Training of Naval flight surgeons dates back to 1921. From 1926 to 1934, the Navy shifted its flight surgeon training from the US Army School of Aviation Medicine to its own Naval Medical School, Washington, D.C. The Army then again assumed the responsibility for the training program in 1934 at its School of Aviation Medicine, Randolph Field, TX.

On 20 NOV 1939, the mission of the Medical Department, Naval Air Station, Pensacola, FL was amended to include training Naval flight surgeons. Then, in OCT 1946, the Secretary of the Navy officially established the School of Aviation Medicine. On 18 AUG 1965, the School of Aviation Medicine was renamed the US Naval Aerospace Medical Institute (NAMI).

On 7 DEC 1992, the Secretary of the Navy authorized changing the official name of this Institute to the Naval Aerospace and Operational Medical Institute (NAOMI); the name change was authorized to reflect more accurately the mission and functions of the command as a resource serving all Naval warfare specialty communities. Just over four years later, the Bureau of Medicine and Surgery authorized the Naval Aerospace and Operational Medical Institute to change its name to the Naval Operational Medical



Institute (NOMI). Once again, the change was enacted to more accurately represent the vision, responsibility, and daily actions of this Naval command.

According to LCDR Savoia-McHugh, a flight surgeon formerly stationed at NOMI's headquarters, there are offices within NOMI that still have a NAMI designation (NAMI Codes 42 and 26 are synonymous with NOMI Codes 42 and 26); NAMI is also currently referred to as BUMED 236 (26 APR 00 email).

## **B. MISSION AND RESPONSIBILITIES**

Overall, NOMI's Code 26 (Physical Evaluations Department) is responsible for determining if aviation candidates are aeronautically qualified. The mission of NOMI's Code 26 Office is to:

1. Provide support for the NOMI Strategic Plan through support and consultative services for operationally related Naval medical matters worldwide.
2. Provide medical evaluations including diagnosis, medical management and disposition, of general and special duty applicants and designated referred personnel.
3. To provide training for Aviation Medical Personnel who will serve all warfare communities.

The Physical Evaluations Department, located at NAS Pensacola, FL, functions as the "Aeromedical and Operational Medical Evaluations Gatekeeper." This department is responsible for providing fifty-four types of physical examinations for various commands, encompassing all programs leading to general duty commissioning / enlistment, and special duty for aviation or other SPECWAR community designations. On average, NOMI performs over 6,500 complete physical evaluations annually. The Physical Evaluation Department activities related to aviation are the following:

1. Provide initial encounters for all aviation students.
2. Determine if applicants, students, and designated individuals are physically qualified and aeronautically adaptable.

Secondary missions include: laboratory functions, audiograms, radiological and other ancillary support for the Clinical Directorate and Hyperbaric Medicine, all medical readiness exams, and convening Special Boards of Flight Surgeons. In addition, Radiation Health Officer, Lab Control Officer, Infectious Disease Officer and Blood Borne Pathogen / Biohazardous Waste and spill clean-up are duties also assigned to Code 26 [[www.nomi.navy.mil/code02/code26.htm](http://www.nomi.navy.mil/code02/code26.htm)].

### **C. NROTC AVIATION SCREENING PROCESS**

Today's Naval aircraft operate in a stringent environment; changing altitudes, performing G-maneuvers, operating in cramped and static cockpits, and breathing pure oxygen can be difficult for humans to cope with. The physiological effects that may result from these stresses can be serious and consequential: blackout, red-out, hypoxia, backache, nausea, ear and sinus blockage, vertigo, etc. Because of this, it's imperative for the Navy to have a sound medical screening process. The screening must highlight and restrict individuals not meeting predetermined physical standards from starting pilot training. This is especially important considering it costs approximately \$2 million to fully train a Naval aviator. If a pilot were to attrite for a pre-existing condition not initially detected, the Navy would be out a costly investment.

As NOMI's medical screening process is currently structured, all potential aviators take two flight physicals (a pre-commissioning flight physical and another upon arriving at Pensacola, FL). There is an exception to this, if the candidate's pre-commissioning physical is not more than approximately ten months old, it is considered current and the individual isn't required to repeat another complete physical before beginning flight training (CDR Black 3 AUG email). Only a review is required in these

circumstances; the extent of the review is based upon the results of the candidate's physical health history questionnaire and the date of their last physical. In all cases, every candidate has their anthropometrical measurements repeated and visual examination scores confirmed (no one performs these exams to the same standards as NOMI). According to CAPT Deakins, head of NOMI's Physical Exams and Evaluations, "About a third of our exams are 'partial,' i.e. they do not require the full exam, but we must do some parts of it to issue an admin up-chit" (12 JUL email).

The pre-commissioning physical required for all aviation candidates is completed prior to service selection and determines if one is eligible to apply for an aviation billet. Any physician can perform this physical as long as the examination covers all of NOMI's specifications. Before the physical is submitted to NOMI Code 42, however, it must be countersigned by a flight surgeon of the uniformed services of the United States—helping to ensure results meet all standards (CAPT Deakins 25 JUL email).

In the pre-commissioning physical, all candidates are subjected to vision, dental, and hearing exams, blood work, anthropometric measurements, urinalysis, EKG monitoring, a chest X-ray, and lastly, a flight surgeon examination or review. Upon the physical's completion, a flight surgeon makes the final determination if the candidate is physically qualified. If an unfavorable determination is made, the individual will most likely be disqualified and the screening process ended (some disqualifying conditions can be overlooked through a waiver process).

In the screening process's second stage, all ensigns sent to Pensacola for flight training undergo another flight physical (or review if within the ten month window) at NOMI's headquarters. This follow-on physical / review is designed to catch erroneous

judgments or measurements taken during the pre-commissioning physical. The physical also ensures that the candidate is physically qualified just prior to beginning pilot training; things can happen to candidates in the months between their pre-commissioning physical and when they actually start flight training (vision may deteriorate, athletic injuries may occur, sickness may develop). NOMI's physical is identical to the pre-commissioning physical, with the exception that those performing the physical are more in tune to NOMI's standards—a tighter level of conformity across candidates is maintained. Upon completing the NOMI flight physical / review, if a flight surgeon determines the candidate physically qualified, the individual is cleared to start Aviation Pre-flight Indoctrination (API) and the initial screening process is finalized. If the candidate is judged not physically qualified, the individual is not eligible for aviation (barring a waiver being granted).

Because of the importance of an up-to-date physical evaluation, the redundancy of NOMI's re-check structure is arguably justified. NOMI must ensure that the day a candidate actually starts aviation training they are physically qualified, and two physicals are required to do this.

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### **III. ATTRITION ANALYSIS OF THE NROTC AVIATION SCREENING PROCESS**

#### **A. OVERVIEW**

This chapter will discuss several problems associated with the NROTC aviation screening process. It will then quantify attrition levels of Student Naval Aviators (SNA) both before and after flight training commences. Lastly, current actions being taken by the Navy to combat its SNA attrition problem will be described.

#### **B. PROBLEMS ASSOCIATED WITH THE NROTC SCREENING PROCESS**

There are several announced problems with NOMI's NROTC aviation candidate screening process. The biggest problem facing NOMI deals with the number of candidates found Physically Qualified (PQ) for aviation service at the pre-commissioning physical and Not Physically Qualified (NPQ) at the NOMI physical.

Perhaps the strongest force driving the screening's attrition deals with the decentralized structure of the NROTC commissioning program. As mentioned in Chapter I, there are fifty-seven NROTC units associated with sixty-nine colleges across America. Table 3.1 on the following page provides a list of all NROTC stand-alone and consortium units; this information was obtained through CNET's web site [[www.cnet.navy.mil/nrotc/nrotc\\_addr\\_phlst.htm](http://www.cnet.navy.mil/nrotc/nrotc_addr_phlst.htm)]. The scattered location of the NROTC program presents a large management, conformity, and tracking problem for NOMI—especially when considering that approximately 150 different facilities are used for pre-commissioning aviation physicals. According to CAPT Deakins, it has been difficult to maintain a consistent uniformity in the NROTC physical screening and reviewing

NROTC Units		NROTC Consortium Units
The University of Arizona	University of Rochester	<b>Atlanta Region Morehouse College</b>
Auburn University	Savannah State University	-Morehouse College
University of California Berkeley	University of South Carolina	-Georgia Tech
Carnegie Mellon University	Southern University and A & M College	<b>Boston University-MIT</b>
The Citadel	State University of New York Maritime College	-Boston University
University of Colorado	University of Texas	-Massachusetts Institute of Technology
Cornell University	Texas A & M University	<b>Chicago Area</b>
University of Florida	Tulane University	-Illinois Institute of Technology
Florida A & M University	University of Utah	-Northwestern University
The George Washington University	Vanderbilt University	<b>Hampton Roads</b>
College of the Holy Cross	University of Virginia-Maury Hall	-Old Dominion University
University of Idaho	Virginia Military Institute	-Norfolk State University
University of Illinois	Virginia Polytechnic Institute and State University	-Hampton University
Iowa State University	University of Washington	<b>Houston</b>
Jacksonville University	University of Wisconsin	-Rice University
University of Kansas		-Prairie View A & M
Maine Maritime Academy		<b>Los Angeles</b>
Marquette University		-University of California, Los Angeles
Miami University		-University of Southern California
University of Michigan		<b>Mid-South Region University of Memphis</b>
University of Minnesota		-University of Memphis
University of Missouri		-University of Mississippi
University of Nebraska		<b>North Carolina Piedmont Region</b>
University of New Mexico		-Duke University
Norwich University		-University of North Carolina
University of Notre Dame		-North Carolina State University
Ohio State University		<b>Philadelphia</b>
University of Oklahoma		-Villanova University
Oregon State University		-University of Pennsylvania
Pennsylvania State University		<b>San Diego</b>
Purdue University		-San Diego State University
Rensselaer Polytechnic Institute		-University of San Diego

Table 3.1 Stand-Alone and Consortium NROTC Units

processes, as well as a standardized automated data processing system (31 MAY 00 email). This overall lack of conformity has resulted in pre-commissioning physical sites performing physicals short of NOMI's standardized level of quality. It has also made it easier for incorrectly documented discrepancies to go unnoticed (until the individuals are examined at NOMI's facilities).

Initially, the research performed for this thesis hinted that another likely cause of discrepancies between the two physicals dealt with the quality of the vision exam given at the pre-commissioning physical; specifically, that a large number of sites used for this physical didn't have the technology needed to perform an accurate visual diagnosis. It was thought that a TOMEY corneal topography eye machine would elevate the accuracy of a candidate's initial vision assessment. According to Peter Leadem, a sales representative for Lombart Instruments (located in Norfolk, VA), a machine such as the TOMEY performs corneal topography functions as well as auto refractions of the eye; this capability allows for a color elevation map of the cornea (checking for uncommon irregularities of the eye) and a close approximation of the candidate's vision (JUL 00 telephone conversation).

Opposing the above viewpoint, LT Carl Ruoff, a Naval Optometrist stationed at NOMI's headquarters, explained that the corneal topographer isn't necessarily the best machine for routine screening of applicants' vision. Upon reviewing the contents of Table 3.2 (a listing of the most common disqualifying vision ailments found by CDR Black's query of NOMI's database), LT Ruoff exclaimed that the corneal topographer could not screen for most of the conditions listed. He stated that an armed forces vision tester (similar to the ones the Department of Motor Vehicles (DMV) uses) would be a



much better piece of equipment for an overall visual assessment. This vision tester, along with a well-trained technician, would be able to screen for all the conditions listed in Table 3.2 (21 JUL email).

In summary, although NOMI has a TOMEY it can use for final vision checks, the machine isn't essential for an accurate visual diagnosis. Therefore, having a TOMEY at every pre-commissioning physical site is not needed; what is required, however, is a general vision scanner and a well-trained flight surgeon or technician.

REFRACTIVE ERROR DDVA, EXCEEDING STANDARDS BOTH EYES FUSION W/DEFECTIVE STEREOPSIS (DEFECTIVE DEPTH PERCEPTION) DM FAILURE OF DEPTH PERCEPTION TEST – VERHOEFF DDVA, EXCEEDING STANDARDS LEFT EYE COLOR VISION DEFICIENCIES DDVA, EXCEEDING STANDARDS RIGHT EYE UNSPECIFIED DISORDERS OF EYE MOVEMENTS (OPHTHALMOPLÉGIA STRABISMUS) CORNEAL DYSTROPHY NOS DDVA, NOT CORRECTED TO 20/20 BOTH EYES
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**Table 3.2 Most Common Disqualifying Eye Conditions**

### **C. ATTRITION LEVELS QUANTIFIED**

#### **1. The NROTC Flight Physical Process**

The information presented below was obtained from CDR James Black, a flight surgeon stationed at NOMI's Code 26 Office. CDR Black produced this information through an exhaustive query of NOMI's database; the data was sorted using Microsoft Access and presented using Microsoft Excel.

The data CDR Black produced cites the number of NROTC midshipmen and officer candidates for whom NOMI performed a flight physical / review on during the years 1995 to 1999. Contained within this data are the total number of candidates

determined to be NPQ, and how many NPQ cases were waived. Table 3.3 summarizes CDR Black's findings.

Source	Reported Number of Applicants	Status	Status Breakdown	Waiver %'s of NOMI NPQ	NPQ % of Reported NOMI Applicants	NPQ % of Reported CNET Applicants	No Waiver % of Reported NOMI Applicants	No Waiver % of Reported CNET Applicants
NOMI Overall	1493	NPQ	149		9.98%	8.03%		
CNET Overall	1856	No Waiver	71	47.65%			4.76%	3.83%
		Waiver	78	52.35%				
NOMI 1995	471	NPQ	43		9.13%	7.92%		
CNET 1995	543	No Waiver	20	46.51%			4.25%	3.68%
		Waiver	23	53.49%				
NOMI 1996	334	NPQ	38		11.38%	10.92%		
CNET 1996	348	No Waiver	14	36.84%			4.19%	4.02%
		Waiver	24	63.16%				
NOMI 1997	223	NPQ	32		14.35%	10.56%		
CNET 1997	303	No Waiver	17	53.13%			7.62%	5.61%
		Waiver	15	46.88%				
NOMI 1988	228	NPQ	18		7.89%	5.59%		
CNET 1998	322	No Waiver	10	55.56%			7.89%	3.11%
		Waiver	8	44.44%				
NOMI 1999	237	NPQ	18		7.59%	5.29%		
CNET 1999	340	No Waiver	10	55.56%			7.59%	2.94%
		Waiver	8	44.44%				

**Table 3.3 Pre-Commissioning Flight Physical Attrition Rates**

There are some problems with the data presented in Table 3.3, however. Due to inaccurate and / or noncompliant data entry, the majority of reporting from locations (universities) of the NROTC candidates found NPQ could not be determined; data errors include entering incorrect UIC's, or failure to enter a UIC at all (a UIC is a code that identifies locations of Navy facilities). Second, as Table 3.3 illustrates, the total number of NROTC individuals identified by NOMI's database to have had a flight physical or

review doesn't agree with the number of Naval aviation candidates identified by the Chief of Naval Education and Training (CNET); CNET analysts Bonnie Weatherholtz and Maryln Tetzlaff provided the CNET aviation student numbers presented in Table 3.3.

There are two plausible explanations for the reported differences in candidate numbers. The information provided by Mrs. Weatherholtz represents the number of midshipmen and officer candidates selected for aviation; however, the figures have been determined to be somewhat overstated. Some of these aviation selectees postponed flight school to pursue a graduate degree, and this isn't reflected in the data. Second, as mentioned in chapter two, about a third of NOMI's exams are partial. CDR Black explained that these partial physicals (or reviews) may have not been entered into the database, understating NOMI's recorded number of physicals (26 JUL email). So, the true number of individuals sent to flight school lies between the ranges presented in Table 3.3—most likely skewed towards the numbers CNET reported.

## **2. Analysis of Attrition Percentages**

NROTC units across the country schedule flight physicals in their students' junior or senior year; either way, there is a time lag between the pre-commissioning and NOMI physical. Because of this time span, it is reasonable to expect that a small number of individuals will be found NPQ by NOMI (the physical status of the candidates may deteriorate during the time). However, as Table 3.3 illustrates, the number of candidates disqualified from 1995 to 1999 appears to be more than expected due to this deterioration. Using NOMI's numbers, the percentage of candidates found NPQ from 1995-1999 was 9.8%, and 8.03% according to CNET's statistics. The overall percentage of candidates not granted a waiver according to NOMI and CNET's data was 4.76% and 3.83%,

respectively. Although the data used to determine the attrition rates is somewhat subjective, and it's impossible to predict how many candidates' physical status declined during the time lag between physicals (they legitimately passed the pre-commissioning physical), the calculated attrition rates seem to show room for improvement. It appears that a lack of conformity (quality) associated with the pre-commissioning physical has been allowing individuals with disqualifying conditions to 'slip' through the first stage of the process's screening.

### **3. The Flight School Attrition Rate**

According to CDR Skinner, Training Wing Five's Plans and Stats Officer, the attrition rate of Student Naval Aviator's (SNA) has historically been around 9.2%. However, for reasons unexplained, the current rate is approximately 11% (an interesting aside to these figures is that attrition levels for Marine students have consistently been four percentage points lower than SNA's). This high attrition rate, the accumulation of large pools of individuals waiting to start various stages of flight training, and problems associated with the physical screening process prompted the Navy to inaugurate the Aviation Certification Evaluation and Screening (ACES) program.

### **D. THE ACES PROGRAM**

All of the information conveyed below was provided by LCDR Rad, the Naval Aviation Schools Command (NASC) ACES program director.

The ACES program, headquartered in Pensacola, FL, is a five day training event that was started in JAN 00. Initially, it has been directed towards individuals entering Officer Candidate School. However, the current plan dictates that, when all needed resources are in place, aviation candidates from all three commissioning sources will be

included. As of AUG 00, 139 students have completed ACES. Table 3.4 provides a breakdown of the results. Note, not all individuals needing anthropometric cockpit fit-checks were disqualified. Also, the 14.4% of ACES inaugural students determined to be NPQ without waiver cannot be related or compared to NROTC attrition rates (OCS ACES students are not subjected to a pre-commissioning flight physical).

<b>Status</b>	<b>Totals</b>	<b>% of Total</b>
Students Screened to Date	139	
Students NPQ (No Waiver)	20	14.4%
Students NPQ (Waiver Granted)	7	5.0%
Students DOR	5	3.6%
Students Re-designated	6	4.3%
Students Needing Remedial PT	26	18.7%
Students Needing Remedial Swim	16	11.5%
Students Needing Cockpit Fit Check	32	23.0%
Students Initially Qualified	68	48.9%

**Table 3.4 Year to Date Results of the ACES Program**

ACES, in essence, provides a thorough screening of future student aviators; the program's first stage assesses the physical status of all candidates with a complete NOMI flight physical and anthropometric cockpit fit-check. The remainder of the program is designed to screen candidates by giving them a realistic exposure to the demands of flight school. Table 3.5 lists the major components of the ACES program.

- NOMI Flight Physical
- Anthropometric Measurements (Cockpit Fit-Checks)
- VT Squadron Tour
- Training Devices Tour / Demo
- API Directors Brief
- OCS Director / Drill Instructor Brief
- OCS Tour / Q & A Session
- PT and Swim Screen
- Carrier Deck Mock-Up Tour
- Naval Aviation Museum Tour
- Flight Gear Familiarization / Flight Safety Briefings
- Simulator Flight / Briefings
- T-34 Training Flight / Briefings

**Table 3.5 Contents of the ACES Program**

Throughout this exposure, ACES highlights the specific struggles of every student in order that their problems may be resolved prior to beginning flight training. Another beneficial aspect of ACES is that it gives students an opportunity to decide if the Naval aviation community is something they really want to pursue; this will most likely reduce the number of candidates that Drop on Request (DOR) once flight school begins—alleviating the “It just wasn’t right for me” scenario.

Overall, the program has the potential to be very beneficial. Because students are given the chance to experience flight school’s demands first hand, they’ll know how to become better prepared. This prior preparation should in turn lower the number of individuals who roll back a class because of preventable difficulties (low PRT scores, insufficient swimming abilities, etc.). It’s also logical to conclude that ACES will decrease the number of SNA’s that drop / fail out of flight school. Lastly, the program provides a means to give an extremely accurate flight physical; this should reduce the number of candidates found NPQ for aviation at the NOMI flight physical given prior to flight school. Furthermore, if needed, the ACES program provides more time for the waiver process.

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#### **IV. COST-BENEFIT ANALYSIS OF ALTERNATIVES TO THE NROTC AVIATION SCREENING PROCESS**

##### **A. OVERVIEW**

This chapter will analyze two alternative means for NOMI to screen NROTC aviation candidates. The costs associated with these alternatives will be quantified and compared against each other and the process as it stands today. Comparisons will be made utilizing a cost-benefit analysis that tracks all relevant statistical data from 1995 to 1999. The chapter will open with an explanation of cost-benefit analyses and conclude with a sensitivity analysis.

##### **B. COST-BENEFIT ANALYSES**

A cost-benefit analysis (CBA) is an analytical tool aimed at helping decision makers estimate resulting costs and gains from alternative courses of action. According to Boardman, Greenberg, Vining, and Weimer, in their book *Cost-Benefit Analysis: Concepts and Practice*, the primary benefits of a CBA are: a systematic categorization of impacts as benefits and costs, valuing these impacts in monetary terms, and determining net benefits.

The underlying purpose of every CBA seeks to allocate resources as efficiently as possible. In order for this to occur, the positive and negative aspects of all alternatives must be translated into a common measure—usually dollars. This is never an easy undertaking; the methods and assumptions needed to place benefits and costs onto an equal plane are often complex and controversial. It's easy to quantify costs; benefits, on the other hand, are intangible and difficult to quantify, sometimes hard to even estimate.

According to OMB Circular No. A-94 (Transmittal Memo No. 64), benefit-cost analysis is recommended as the technique to use in formal economic analysis of



government programs or projects. Further, the circular states that the standard criterion for deciding whether a government program can be justified on economic principles is net present value (the discounted monetized value of the CBA's expected net benefits). This discounting allows benefits and costs occurring in different time periods to be fairly compared against one another.

OMB A-94 instructs that in instances where monetary values of some benefits or costs cannot be determined, a comprehensive enumeration of the different types of benefits and costs, monetized or not, should be used to help identify the possible range of program effects. Second, benefits and costs should always be quantified, even when it isn't feasible to assign dollar values; here, physical measurements may be possible and useful. Lastly, when constant-dollar (real) amounts represent the CBA's benefits and costs, the proper discount rate to use is 7%. This rate approximates the marginal pretax rate of return on an average private sector investment in recent years.

### **C. INTRODUCTION TO ALTERNATIVES ANALYZED**

The underlying objective of the alternatives being analyzed is to decrease the number of aviation candidates found physically qualified at the pre-commissioning flight physical and not physically qualified at NOMI's physical; the overall goal is to make the screening process more efficient and cost-effective. The different options explored, however, are very different; one restructures the pre-commissioning flight physical while the other sends all aviation candidates to Pensacola, FL for their initial flight physicals (as well as the ACES program). All alternatives are meticulously described in the following text.

## **D. ALTERNATIVE ONE: RESTRUCTURING THE PRE-COMMISSIONING FLIGHT PHYSICAL**

### **1. Description**

Alternative one is the most complex option analyzed by this CBA. Restructuring the pre-commissioning flight physical is an optimization problem with its goal being to determine the best flight physical site for every NROTC unit. This optimal assignment, taking into consideration all relevant variable and fixed costs, will minimize the number of facilities used for NROTC physicals, and overall cost.

The basis driving alternative one is that reducing the number of facilities would make it easier for NOMI to standardize this stage of the screening to their specifications. This should, in turn, increase the accuracy of the physical's results—decreasing the number of candidates found NPQ at the second flight physical. Also, minimizing facilities used for the pre-commissioning flight physical would help with the uniformity of data processing associated with the physical. This theoretically should reduce the number of documentation errors and enable NOMI to better track the overall performance of the facilities used for the screening—highlighting the locations incorrectly passing candidates with disqualifying conditions.

### **2. Methodology**

The methodology followed in analyzing alternative one is as follows:

1. Determine DoN domestic health care facilities in which Navy flight surgeons are stationed.
2. Determine the location of every NROTC unit.
3. Create a distance matrix representing the distances from every NROTC unit to every flight surgeon location.
4. Identify all variable costs associated with sending candidates to sites having flight surgeons (per diem rates, reimbursable mileage rates, air travel costs).
5. Identify the number of aviation candidates produced from every NROTC unit.
6. Determine average cost and aviator production numbers.

7. Assign a fixed cost value for using a flight surgeon facility.
8. Implement the distance and averaged cost and production data into an optimization program to determine the optimal assignment solution.
9. Use the optimal assignments (generated from the averaged data) to determine what the resulting 1995-1999 yearly costs would have been.

### **3. Creating a Distance Matrix**

The first step in restructuring the pre-commissioning physical was to determine the location of all domestic DoN facilities capable of giving a flight physical. The resources needed to conduct this physical are very basic, and can be found in almost every Navy hospital or medical clinic. The main constraint is that the physical must be performed, or countersigned, by a flight surgeon of the US armed forces. Because the goal of the restructuring is to increase the physical's conformity to NOMI's standards, only locations with active duty Navy flight surgeons were selected.

Three sources were compiled to determine the Naval health service facilities and air stations having flight surgeons: *The 2000 Guide to US Military Installations*, correspondence with LCDR Steve Keener, the Navy Personnel Command's flight surgeon placement officer, and the Naval Medical Information Management Center's web site [<http://navmedinfo.med.navy.mil/mfaclink1.htm>]. All the health care facilities and air stations identified by these sources were contacted to confirm their flight surgeon status. Table 4.1 shows the medical facilities supported by a Naval flight surgeon considered by alternative one. This table is not a Navy-wide aggregate listing; a number of branch and ambulatory clinics were excluded because of their proximity to a Naval air station, or larger Naval hospital.

Table 4.1 contains thirty-two facilities and is organized as follows: locations with a backslash indicate two facilities are located within the same zip code; further, the

facility listed first represents the location where flight physicals are actually performed. For example, all physicals supporting NAS Brunswick are done at the Branch Medical Clinic (BMC) Brunswick. The relationships Table 4.1 presents were determined by speaking with health care personnel at the specific clinics and air stations listed.

Facility	
AFB Tinker	NAS Kingsville
BMC / NAS Brunswick	NAS Meridian
BMC / NAS China Lakes	NAS / NACC New Orleans
BMC / NAS Point Mugu	NAS North Island / NMC San Diego
BMC Milington	NAS Oceana
MAG 39 / NH Camp Pendleton	NAS Pensacola
MCAS / NH Beaufort	NACC Newport
MCAS Miramar	NACC Portsmouth, NH
MCAS New River	NH / MCAS Cherry Point
MCAS Yuma	NH / NAS Corpus Christi
NAS Atlanta	NH Great Lakes, IL
NAS Fallon	NH / NAS Lemoore
NAS Fort Worth	NH Oak Harbor / NAS Whidbey
NAS / NH Jacksonville	NMC Annapolis, MD
NAS Key West	NMC / NAS Pax River
NAS JRB Willow Grove	NMC Quantico, VA

**Table 4.1 Flight Surgeon Locations Considered by Alternative One**

With all relevant flight surgeon locations identified, a matrix containing the distance from every NROTC unit to every facility having a flight surgeon was created. The distances were determined using Yahoo! Driving Directions [<http://maps.yahoo.com/py/ddResults.py>]. Table 4.2 displays the resulting matrix (highlighted cells represent distances under 420 miles).

Zip	City	State	University	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500
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#### **4. The Optimal Pre-commissioning Flight Physical Structure**

##### ***a. Introduction to GAMS***

The General Algebraic Modeling System (GAMS) was used to determine alternative one's optimal solution. This model utilized a GAMS-Excel interface designed by Maliyev and Rutherford at the University of Colorado; this interface allows for the importing and exporting of data to Excel spreadsheets. Professor Rob Dell, from the Naval Postgraduate School's Operations Research Department, and his Summer Quarter 00 OA 4203 Advanced Mathematical Programming Seminar Class were given a brief of the pre-commissioning flight physical attrition problem, the objectives of the restructuring, and all required data (in spreadsheet form). Professor Dell, specifically Major Robert Liebe (a student in the OA 4203 Class), produced the optimal GAMS solution.

##### ***b. Structure of the Formulated GAMS Model***

Because it would be inefficient to change pre-commissioning flight physical assignment locations from year to year, and all required data was only available for a five-year period from 1995 to 1999, hindsight was required to structure the GAMS model. Implementing the five-year average of the obtainable data allowed the model to better weigh the number of aviation candidates produced from each NROTC unit. This was important considering that GAMS optimal assignments will determine specific yearly screening costs (these yearly breakdowns will reflect changing aviator production and cost data, while holding assignment locations constant). Simply, the hindsight (using future year average data) made the model more feasible and accurate.

*c. Restructuring Cost Data Quantified*

In restructuring flight physical assignments, variable travel costs were the primary factor taken into consideration. This reflects the fact that, no matter where candidates are taken for their pre-commissioning physicals, these physicals must still be done. In this broad sense, costs such as overhead, blood / lab work, and X-ray film would not be considered variable—justifying their exclusion. If a selected facility ends up doing flight physicals for a significant number of aviation candidates, however, their budget may need to be adjusted accordingly.

There was only one fixed cost considered by the GAMS model. If a facility having a flight surgeon was selected to screen NROTC aviation candidates, a flight surgeon from that command would be flown to NOMI's headquarters for a bi-annual two-day training seminar starting in 1995.

The variable travel costs used to analyze alternative one included: Personnel Support Detachment's (PSD) Temporary Active Duty (TAD) cost per mile driven, lodging and meal per diem rates, and costs associated with airline travel. Historic TAD mileage reimbursable rates were obtained from personnel at the Naval Postgraduate School (these rates can be seen in Tables 4.10 - 14). Per diem rates associated with potential physical assignment locations were determined by speaking with DK3 Salas at the Naval Postgraduate School, as well as using DoD's Per Diem Committee web site [[www.dtic.mil/perdiem/](http://www.dtic.mil/perdiem/)]. Table 4.3 is a historical listing of all per diem costs relevant to alternative one (L denotes the lodging rate, M signifies the meals rate). Lastly, the yearly production of NROTC aviators (midshipmen and officer candidates) from each NROTC unit was required to ensure the restructuring model's accuracy. This information, presented in table 4.4, was obtained from CNET's Bonnie Weatherholtz.

		AFB Tinker	BMC / NAS Brunswick	BMC / NAS China Lakes	BMC / NAS Point Mugu	BMC Millington	MAG 39 / NH Beaufort	MCA's Miramar	MCA's New River	MCA's Yuma	NAS Atlanta	NAS Fallon	NAS Fort Worth	NAS / NH Jacksonville	NAS JRB Willow Grove	NAS Kingsville	NAS Meridian	NAS / NAOC New Orleans	NAS North Island / NMC San D.	NAS Oceana	NAS Pensacola	NAOC Newport	NAOC Portsmouth, NH	NH / MCAS Cherry Point	NH / NAS Corpus Christi	NH Great Lakes	NH / NAS Lemore	NH Oak Harbor / NAS Whidbey	NMC Annapolis	NMC / NAS Pax River	NMC Quantico	
FY 1995 Per Diem	L	56	56	60	102	57	81	46	81	40	60	81	40	71	50	83	44	40	66	81	61	57	62	53	42	64	104	62	49	76	51	50
	M	26	30	34	38	34	40	34	40	26	28	40	26	36	32	34	28	26	36	40	36	32	36	26	32	40	30	32	40	26	30	
FY 1996 Per Diem	L	56	65	60	97	64	81	74	81	47	60	85	40	84	58	80	43	40	70	81	68	60	77	53	53	64	119	68	68	86	57	50
	M	30	34	38	38	30	34	38	34	26	26	34	26	38	30	34	26	26	34	34	34	30	38	34	26	34	38	34	36	30	30	
FY 1997 Per Diem	L	66	65	64	97	69	84	83	84	50	64	96	50	84	65	80	50	50	70	84	77	62	81	56	53	64	119	68	59	86	59	53
	M	30	38	38	42	30	38	34	38	30	38	30	42	30	38	30	30	30	42	38	38	34	42	34	30	42	34	34	38	34	30	
FY 1998 Per Diem	L	65	63	66	109	79	93	128	93	50	64	97	50	94	73	84	50	50	88	93	64	59	81	57	84	120	70	54	96	59	50	
	M	30	38	38	42	30	38	34	38	30	38	30	42	30	38	30	30	42	42	38	38	34	42	34	30	42	34	34	38	34	30	
FY 1999 Per Diem	L	59	58	58	99	79	96	110	96	50	52	90	50	94	63	84	50	50	88	96	54	52	77	59	71	108	53	84	90	59	62	
	M	38	38	34	38	38	46	42	46	30	34	38	30	38	34	42	30	30	42	46	38	34	42	42	34	42	38	34	42	34	34	
Average (95-99)	L	60	61	62	101	70	87	88	87	47	60	90	46	85	62	82	47	46	76	87	65	58	76	56	61	114	64	63	87	57	53	
	M	31	36	36	40	32	39	36	39	28	30	38	28	39	31	37	29	28	39	39	37	33	41	36	29	32	41	34	39	32	31	



University	FY 95	FY 96	FY 97	FY 98	FY 99	AVG
Arizona	17	14	10	5	6	10.4
Auburn	11	13	5	13	8	10.0
Boston-MIT	21	9	8	7	6	10.2
Cal Berkeley	4	3	3	0	2	2.4
Carnegie Mellon	8	2	2	7	3	4.4
Chicago Area	11	9	3	3	6	6.4
Colorado	19	9	13	10	6	11.4
Cornell	4	3	9	2	8	5.2
Florida	9	7	10	11	10	9.4
Florida A & M	2	2	6	7	3	4.0
George Washington	13	13	12	5	10	10.6
Hampton Roads	16	6	12	17	22	14.6
Holy Cross	6	3	2	1	6	3.6
Houston	2	1	4	5	4	3.2
Idaho	8	7	6	3	4	5.6
Illinois	17	8	7	3	9	8.8
Iowa state	8	5	3	3	6	5.0
Jacksonville	26	19	8	19	17	17.8
Kansas	10	6	2	4	1	4.6
UCLA / USC	17	12	6	5	3	8.6
Maine Maritime Academy	7	3	6	5	3	4.8
Marquette	6	4	4	1	3	3.6
Miami	9	6	7	6	3	6.2
Michigan	4	4	4	4	3	3.8
Mid South Region of Memphis	8	5	7	15	3	7.6
Minnesota	6	1	0	2	6	3.0
Missouri	3	1	0	3	2	1.8
Morehouse / Georgia Tech	13	6	6	8	7	8.0
Nebraska	7	3	2	4	4	4.0
New Mexico	0	0	2	3	1	1.2
New York Maritime College	5	2	4	3	4	3.6
Norwich	1	1	1	2	4	1.8
Noter Dame	21	13	2	10	7	10.6
North Carolina / Piedmont	9	6	10	10	9	8.8
Ohio State	18	9	5	9	8	9.8
Oklahoma	5	9	1	3	3	4.2
Oregon State	13	7	6	0	6	6.4
Pennsylvania State	15	11	7	6	8	9.4
Philadelphia	15	9	9	9	7	9.8
Purdue	5	5	7	8	5	6.0
Rochester	4	3	2	1	1	2.2
RPI	12	7	7	9	10	9.0
San Diego State / San Diego	14	12	8	8	12	10.8
Savannah state	3	2	4	1	0	2.0
South Carolina	9	5	3	2	7	5.2
Southern and A & M	0	0	0	3	3	1.2
Texas	4	4	6	5	4	4.6
Texas A & M	19	7	6	9	16	11.4
The Citadel	5	4	6	8	11	6.8
Tulane	22	17	7	6	7	11.8
Utah	1	1	0	4	8	2.8
Vanderbilt	10	7	7	2	3	5.8
Virginia	13	6	8	4	5	7.2
VMI	5	3	4	3	5	4.0
VPI	9	8	8	7	7	7.8
Washington	11	3	3	8	5	6.0
Wisconsin	3	3	3	1	0	2.0
	543	348	303	322	340	371.2

Table 4.4 Yearly NROTC Unit Aviator Production Numbers

*d. Modeling Assumptions and Costing Techniques*

The following modeling assumptions were used in solving alternative one:

1. The mileage an aviation candidate could travel to a flight surgeon location was limited to 1,200 (this to prevent coast-to-coast flight physicals).
2. CNET NROTC aviator production numbers, although somewhat overstated, were used in the GAMS model.
3. CNET and NOMI data were combined / compared despite the fact that they refer to fiscal and calendar years, respectively; this was deemed acceptable because of the overlapping nature of a school year.
4. The pre-commissioning flight physical training seminar for flight surgeons from selected sites would increase the conformity of the physical—lowering the attrition rate. This knowledge would then be passed on in turnovers.
5. Capacity issues associated with pre-commissioning flight physicals were not considered; if a problem, this could be solved through proper scheduling.
6. Flight surgeon locations were selected because of associated travel costs; locations performing greater numbers of flight physicals were not considered more preferable.

For GAMS to utilize Table 4.2's distance matrix required translating these distances into costs; to alleviate costing confusion, a description of the costing methodology is provided in the following paragraphs.

Individuals traveling for a flight physical and returning to their duty stations are considered to be on TAD travel; this travel is subject to the following rules and regulations. On actual days of travel (i.e. moving from point A to B), if individuals are gone more than twelve hours, they're entitled to 75% of the designated meal per diem rate. If an overnight stay is required, regardless if it's a travel day or not, 100% of the lodging per diem amount is authorized. Further, on non-travel TAD days, 100% of the lodging and meal per diem rates are paid. There is one exception to the above rules; if government lodging and meals are available, individuals will only be reimbursed the amount the government charged—not the maximum allowed. Lastly,

miles traveled are reimbursed at the TAD government rate per mile, and if air travel required, the government (usually at a negotiated discount) purchases the tickets.

Considering PSD's TAD rules, the following formulas and assumptions were used to translate flight physical distances to costs:

1. If distance traveled < 200 miles, assigned cost = (distance\*TAD reimbursement amount per mile\*2) + (.75\*meals per diem rate).
2. If distance traveled > 200 and < 420 miles, assigned cost = (distance\*TAD reimbursement amount per mile\*2) + (1.5\*meals per diem rate) + (lodging per diem rate).
3. If distance traveled > 420, assigned cost = (price of airline ticket) + (1.5\*meals per diem rate) + (lodging per diem rate).
4. If a health care facility containing a flight surgeon were selected, a flight surgeon from the command would attend a bi-annual two-day training seminar at NOMI's headquarters. Assigned cost = (price of airline ticket) + (3.5\*meals per diem rate) + (3\*lodging per diem rate).
5. The full TAD reimbursable mileage rate was used to represent an upper-bound cost limit. Many NROTC units use Navy vans to transport their aviation candidates to flight physicals (specifics were undeterminable); in these circumstances, the full TAD mileage rate wouldn't apply to every individual.
6. It was impossible to quantify historical costs of airline tickets; therefore, a ticket cost of \$400, across all years, was implemented into the model.

Table 4.5 portrays the results of using the above formulas to translate Table 4.2's distances into costs. These values were determined using average aviator production numbers and travel costs from 1995 to 1999. The information contained within this table is what GAMS used to determine optimal assignment solutions. Notice that costs associated with NAS Key West are not included in the table; this because there wasn't an NROTC unit less than 420 miles away from the air station.

*e. The Optimal Pre-Commissioning Flight Physical Structure*

Using average data, the optimal assignment pattern GAMS recommended is shown in Table 4.6. This solution reduced the number of facilities performing pre-commissioning flight physicals from approximately 150 to seventeen. The average

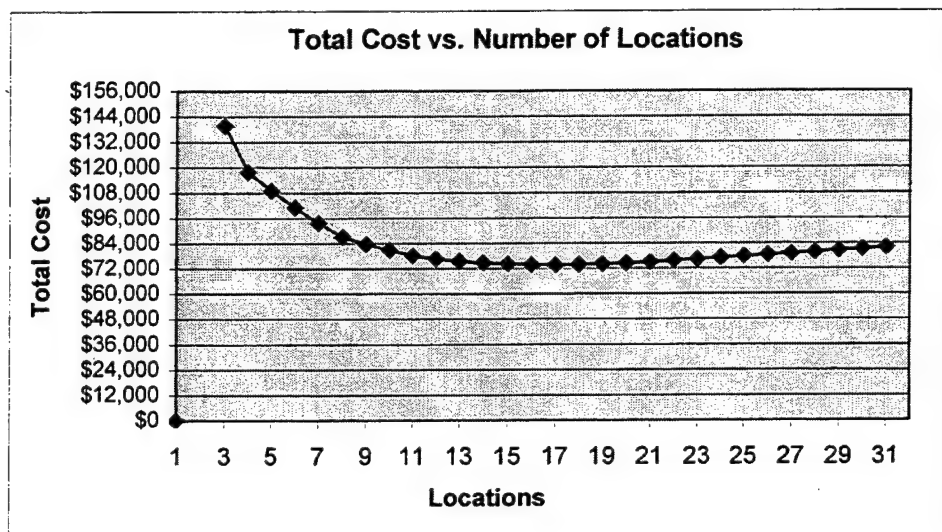
Phir Date	6004	6014	6018	6020	6022	6024	6026	6028	6030	6032	6034	6036	6038	6040	6042	6044	6046	6048	6050	6052	6054	6056	6058	6060	6062	6064	6066	6068	6070	6072	6074	6076	6078	6080	6082	6084	6086	6088	6090	6092	6094	6096	6098	6100	6102	6104	6106	6108	6110	6112	6114	6116	6118	6120	6122	6124	6126	6128	6130	6132	6134	6136	6138	6140	6142	6144	6146	6148	6150	6152	6154	6156	6158	6160	6162	6164	6166	6168	6170	6172	6174	6176	6178	6180	6182	6184	6186	6188	6190	6192	6194	6196	6198	6200	6202	6204	6206	6208	6210	6212	6214	6216	6218	6220	6222	6224	6226	6228	6230	6232	6234	6236	6238	6240	6242	6244	6246	6248	6250	6252	6254	6256	6258	6260	6262	6264	6266	6268	6270	6272	6274	6276	6278	6280	6282	6284	6286	6288	6290	6292	6294	6296	6298	6300	6302	6304	6306	6308	6310	6312	6314	6316	6318	6320	6322	6324	6326	6328	6330	6332	6334	6336	6338	6340	6342	6344	6346	6348	6350	6352	6354	6356	6358	6360	6362	6364	6366	6368	6370	6372	6374	6376	6378	6380	6382	6384	6386	6388	6390	6392	6394	6396	6398	6400	6402	6404	6406	6408	6410	6412	6414	6416	6418	6420	6422	6424	6426	6428	6430	6432	6434	6436	6438	6440	6442	6444	6446	6448	6450	6452	6454	6456	6458	6460	6462	6464	6466	6468	6470	6472	6474	6476	6478	6480	6482	6484	6486	6488	6490	6492	6494	6496	6498	6500	6502	6504	6506	6508	6510	6512	6514	6516	6518	6520	6522	6524	6526	6528	6530	6532	6534	6536	6538	6540	6542	6544	6546	6548	6550	6552	6554	6556	6558	6560	6562	6564	6566	6568	6570	6572	6574	6576	6578	6580	6582	6584	6586	6588	6590	6592	6594	6596	6598	6600	6602	6604	6606	6608	6610	6612	6614	6616	6618	6620	6622	6624	6626	6628	6630	6632	6634	6636	6638	6640	6642	6644	6646	6648	6650	6652	6654	6656	6658	6660	6662	6664	6666	6668	6670	6672	6674	6676	6678	6680	6682	6684	6686	6688	6690	6692	6694	6696	6698	6700	6702	6704	6706	6708	6710	6712	6714	6716	6718	6720	6722	6724	6726	6728	6730	6732	6734	6736	6738	6740	6742	6744	6746	6748	6750	6752	6754	6756	6758	6760	6762	6764	6766	6768	6770	6772	6774	6776	6778	6780	6782	6784	6786	6788	6790	6792	6794	6796	6798	6800	6802	6804	6806	6808	6810	6812	6814	6816	6818	6820	6822	6824	6826	6828	6830	6832	6834	6836	6838	6840	6842	6844	6846	6848	6850	6852	6854	6856	6858	6860	6862	6864	6866	6868	6870	6872	6874	6876	6878	6880	6882	6884	6886	6888	6890	6892	6894	6896	6898	6900	6902	6904	6906	6908	6910	6912	6914	6916	6918	6920	6922	6924	6926	6928	6930	6932	6934	6936	6938	6940	6942	6944	6946	6948	6950	6952	6954	6956	6958	6960	6962	6964	6966	6968	6970	6972	6974	6976	6978	6980	6982	6984	6986	6988	6990	6992	6994	6996	6998	7000													
Aviators	Zip	71148	481	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	3984	

### Table 4.5 Traveling Cost Values Imputed Into GAMS

TAD Reimbursement Per Mile	\$ 0.311
Fixed Cost of Selecting Location	\$ 689.5
Price of an Airline Ticket	\$ 400.0

[illegible]

minimum total travel cost, obeying all assumptions, was \$73,689 (remember, this does not reflect the cost of performing the physicals). Table 4.7 demonstrates the relationship between the number of locations used, and total overall cost. Note, because of the 1,200-mile traveling restriction, the minimal number of facilities able to accommodate every NROTC unit is three.



**Table 4.7 Total Cost vs. the Number of Flight Surgeon Locations Used**

With optimal assignments determined and cost minimized, it's possible to calculate specific yearly expenses, and compare these average costs to what GAMS generated; Table 4.8 presents these costs. As one can see, the average is close, however

	1995	1996	1997	1998	1999	Average
<b>Total Cost</b>	\$ 100,532.60	\$ 54,737.30	\$ 64,304.30	\$ 54,364.86	\$ 69,259.89	\$ 68,639.79

**Table 4.8 Actual Restructuring Costs by Year**

lower than the GAMS prediction. The 6.8% difference is attributable to rounding and the fact that flight surgeons underwent bi-annual training sessions. This makes sense, not every year has a fixed cost associated with it; therefore, the GAMS cost estimate should be higher than the average of actual yearly costs (specific yearly costs can be seen in



Tables 4.10 through 4.14). Programming the model to send flight surgeons to yearly training seminars resulted in an average cost of \$73,335.19. This amount is only .479% off the predicted GAMS cost—ensuring the model’s accuracy.

To equally compare alternatives, the time-value of money must be reflected in their cost totals. Using a rate of 7%, as directed by OMB Circular A-94, the present value (1999) of alternative one’s yearly expenses is \$399,885.56; Table 4.9 shows this detailed breakdown.

	1995	1996	1997	1998	1999	Total
<b>FV</b>	\$131,777.73	\$67,055.55	\$73,621.99	\$58,170.40	\$69,259.89	\$399,885.56

**Table 4.9 Alternative One’s Time-Valued Costs**

#### **E. ALTERNATIVE TWO: OPENING THE ACES PROGRAM TO NROTC AVIATION CANDIDATES**

##### **1. Description**

Alternative two incorporates all NROTC aviation candidates into the ACES program. This would result in candidates taking an extremely accurate NOMI pre-commissioning flight physical, as well as having the opportunity to experience many of flight school’s demands. This experience, in essence, is a screening; it will highlight problematic areas for each individual (if there are any). To minimize the amount of time between the ACES screening and flight school, candidates would be sent in their senior (or fifth) year of college.





[illegible]

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Bear in mind that alternative's one and two are not direct substitutes for one another. The ACES program, because of the flight school exposure it gives, will also most likely lower the number of SNAs that fail to complete flight school; quantification of this additional benefit is beyond the scope of this thesis.

## **2. Methodology and Assumptions**

The methodology followed in analyzing alternative two is as follows:

1. Identify all variable costs associated with sending NROTC potential aviators to the ACES program.
2. Identify the total yearly number of aviation candidates produced from the NROTC commissioning program.
3. Identify the number of individuals within driving distance of Pensacola, FL.

The following assumptions were used to determine alternative two's costs:

1. The price of all airline tickets, regardless of departure location, was \$400.
2. The costs recognized by the model were: traveling expenses, lodging, meals, traveling per diem rates, and a T-34 ride. Costs such as performing the flight physical, organizing the program, transporting individuals to and from the airport, instructors' salaries, and simulator time were excluded.
3. The percentage of ACES 139 inaugural candidates found NPQ without wavier (14.38%) was applied to the costing model (using rounding). These individuals were not given a T-34 flight, and were sent home on the second day (requiring one night of lodging and three meals).
4. Candidates within 420 miles of Pensacola drove to ACES. The model reflects this cost including disqualifying 14.38% of the total driving population. NROTC units driving to ACES are: Auburn, Florida, Florida A & M, Jacksonville, Morehouse / Georgia Tech, Southern A & M, and Tulane.
5. Potential costs involved with changing airline tickets were not considered.

## **3. NROTC ACES Variable Costs**

Determining the cost of sending all NROTC aviation candidates through the ACES program is fairly simplistic. Navy offices related to the ACES activity in question were contacted to determine appropriate charges; the following paragraph gives the source, and cost estimates for the specific activities comprising the program.

LCDR Rad, ACES Program Director, stated that all ACES students stay in the Bachelors Enlisted Quarters (BEQ), and dine at the governmental galley. According to Sally J. Miller, an accounts receivable employee for the BEQ at NAS Pensacola, the cost of a single BEQ room was \$9.60 from 1995 to 1997, and \$12 thereafter. Individuals running the galley stated that the cost per galley meal has remained relatively constant from 1995 to 1999; this rate has been approximately \$3. The ACES program is a five-day event; students arrive on Sunday afternoon / evening and leave on the following Friday (most likely in the early afternoon). Taking this into consideration, the model charged five nights and fifteen meals for every candidate found physically qualified.

One of ACES major benefits is that all aviation candidates receive a T-34 flight. According to Major Utke, USMC, VT-4's operations officer, the variable costs associated with this flight come to \$400 per hour; this cost reflects all maintenance and fuel charges—everything but the pilot's salary. The final costs reflected in the model deal with expenses attributable to transporting candidates to and from Pensacola, FL; these are travel per diem charges and actual transportation costs.

#### **4. Total NROTC ACES Costs**

Table 4.15 on the following page provides a complete yearly cost breakdown of the ACES program. Once again, to foster equal comparison, the present (1999) value of this alternative's costs were computed using the 7% rate; the results are displayed in Table 4.16.

	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>Total</b>
<b>FV</b>	\$596,863.33	\$353,249.57	\$292,973.40	\$290,623.80	\$289,636.27	\$1,823,346.38

**Table 4.16 Alternative Two's Time-Valued Costs**

		1995	1996	1997	1998	1999
<b>Total Number of Candidates</b>		<b>543</b>	<b>348</b>	<b>303</b>	<b>322</b>	<b>340</b>
<b>Air Travel</b>	Disqualified Candidates	66	41	38	36	43
	Physically Qualified Candidates	394	243	223	219	242
<b>Vehicle Travel</b>	Disqualified Candidates	12	9	6	10	6
	Physically Qualified Candidates	71	55	36	57	49
<b>Cost of Qualified Candidates Requiring Airline Tickets</b>						
	Lodging (\$9.60, \$12 per night / 5 nights)	\$ 18,912	\$ 11,664	\$ 10,704	\$ 13,140	\$ 14,520
	Meals (\$3 per meal / 15 meals)	\$ 17,730	\$ 10,935	\$ 10,035	\$ 9,855	\$ 10,890
	Airline Ticket (\$400)	\$157,600	\$ 97,200	\$ 89,200	\$ 87,600	\$ 96,800
	Travel Per Diem Rates (Table 4.4)	\$ 18,912	\$ 10,935	\$ 11,373	\$ 11,169	\$ 12,342
	T-34 Flight (\$400)	\$157,600	\$ 97,200	\$ 89,200	\$ 87,600	\$ 96,800
<b>Cost of Disqualified Candidates Requiring Airline Tickets</b>						
	Lodging (\$9.60, \$12 per night / 1 night)	\$ 634	\$ 394	\$ 365	\$ 432	\$ 516
	Meals (\$3 per meal / 3 meals)	\$ 594	\$ 369	\$ 342	\$ 324	\$ 387
	Airline Ticket (\$400)	\$ 26,400	\$ 16,400	\$ 15,200	\$ 14,400	\$ 17,200
	Travel Per Diem Rates (Table 4.4)	\$ 3,168	\$ 1,845	\$ 1,938	\$ 1,836	\$ 2,193
<b>Cost of Qualified Candidates with Vehicular Travel</b>						
	Lodging (\$9.60, \$12 per night / 5 nights)	\$ 3,408	\$ 2,640	\$ 1,728	\$ 3,420	\$ 2,940
	Meals (\$3 per meal / 15 meals)	\$ 3,195	\$ 2,475	\$ 1,620	\$ 2,565	\$ 2,205
	TAD Reimbursable / Mile (Table 4.3)	\$ 12,465	\$ 9,622	\$ 6,498	\$ 10,907	\$ 9,173
	Travel Per Diem Rates (Table 4.4)	\$ 3,408	\$ 2,475	\$ 1,836	\$ 2,907	\$ 2,499
	T-34 Flight (\$400)	\$ 28,400	\$ 22,000	\$ 14,400	\$ 22,800	\$ 19,600
<b>Cost of Disqualified Candidates with Vehicular Travel</b>						
	Lodging (\$9.60, \$12 per night / 1 night)	\$ 115	\$ 86	\$ 58	\$ 120	\$ 72
	Meals (\$3 per meal / 3 meals)	\$ 108	\$ 81	\$ 54	\$ 90	\$ 54
	TAD Reimbursable / Mile (Table 4.3)	\$ 2,119	\$ 1,631	\$ 1,038	\$ 1,936	\$ 1,140
	Travel Per Diem Rates (Table 4.4)	\$ 576	\$ 405	\$ 306	\$ 510	\$ 306
<b>Total Cost</b>		<b>\$455,344</b>	<b>\$288,357</b>	<b>\$255,894</b>	<b>\$271,611</b>	<b>\$ 289,636</b>

**Table 4.15 Cost Breakdown of the ACES Program**

**F. ALTERNATIVE THREE: IMPLEMENTING NO CHANGE TO THE CURRENT SCREENING SYSTEM**

**1. Description**

This alternative maintains the current process for screening NROTC aviation candidates; no change will be 'instituted' for comparison purposes. Instead, making use of CDR Black's derived attrition numbers, costs associated with moving NPQ (without waiver) candidates will be determined and compared against alternatives one and two. The results of alternative three should be looked upon as potential savings; its costs would greatly be reduced if pre-commissioning flight physicals were made to be more accurate.

**2. Explanation of Changing Flight School Orders**

The following discussion intends to clarify the type of flight school orders candidates have received over the years. The information was provided by LT Michael Moran, Flight Student Placement / Assistant VP Placement Officer, and was used to shape alternative three's costing model.

The type of orders issued to aviation candidates reporting to Pensacola, FL have changed three times in the last eight months. Prior to DEC 99, all potential aviators were given PCS orders. Technically, these orders were illegal because Joint federal Travel Regulations (JFTR) mandate that individuals can't PCS to a duty station / school less than twenty weeks. However, this instruction was ignored because the orders, for several reasons, were proving to be cost-effective. The vast majority of ensigns reporting to flight school were not coming from a permanent duty station so they were not eligible for



a Dislocation Allowance (DLA); second, because it was a college transition, candidates were moving very little to Pensacola (approximately 2,000 lbs on average).

However, several instances of individuals moving the maximum poundage allowed (12,000 lbs for an ensign with dependents), raised questions about the legality of the orders—and they were changed. Individuals reporting to flight school were now only authorized to move the TDY travel allowance of 600 lbs; the remaining portion of their household goods were put into storage, to be shipped to final reporting destinations. Further, upon arrival to Pensacola, all candidates were paid per diem. Hindsight, however, showed that paying so many people per diem was extremely expensive, so the orders were changed again.

Currently, reporting ensigns are only allowed the TDY travel allowance of 600 lbs (with remaining poundage put into storage); however, they are not allocated daily per diem—they are authorized Pensacola's BAH rate. There is one exception to this rule: individuals with a prior PCS move are still only authorized to move 600 lbs, however, they are paid per diem.

### **3. Relevant Moving Rules and Regulations**

The following rules and regulations were provided by PSD personnel at the Naval Postgraduate School. There are two primary costs associated with moving military personnel to new duty stations: transporting individuals and moving their household goods.

Ensigns without dependents transiting to a new command are allocated \$.15 per mile driven and \$50 per travel day; Table 4.17 reflects the chart used to determine authorized travel days. The cost of transporting household goods depends on the distance

and poundage being moved; these rates can be found in the Military Traffic Management Command's Personal Property Accessorial Services Pamphlet.

Miles	Authorized Travel Days
1 - 400	1
401 - 750	2
751 - 1100	3
1101 - 1450	4
1451 - 1800	5
1801 - 2150	6
2151 - 2500	7
2501 - 2850	8
2851 - 3200	9
3201 - 3350	10
3551 - 3900	11
3901 - 4250	12
4251 - 4600	13
4601 - 4950	14

**Table 4.17 Authorized Travel Days**

#### **4. Modeling Assumptions and Costing Techniques**

1. Yahoo! Driving Directions was used to determine mileage between locations. This is not the distance source used by PSD, however, it was used to maintain consistency across alternatives.
2. Origination locations for candidates NOMI found NPQ couldn't be determined, so the average distance from all NROTC units to Pensacola was used to compute excess moving costs. This logic was also followed in computing average moving costs to Newport, RI.
3. The costs alternative three considered included moving individuals and their authorized household goods (the costs of storage were excluded because items would be put in storage regardless of whether an individual was found NPQ).
4. 2,000 lbs was used for the amount of goods an ensign would move.
5. Ensigns found NPQ were sent to Surface Warfare Officers School (SWOS) in Newport, RI.
6. The average moving cost formula for 2000 lbs going to Pensacola is: cost =  $(2000 * \text{Personal Property Accessorial Services Pamphlet designated charge for moving 2000 lbs 1085.49 miles } (.4085)) + (\text{miles traveled} * .15) + (\text{authorized travel days} * 50)$ .
7. The average moving cost formula for 600 lbs going to Pensacola is: cost =  $(600 * (\text{Personal Property Accessorial Services Pamphlet designated charge for moving 600lbs 1085.49 miles } (.6975))) + (\text{miles traveled} * .15) + (\text{authorized travel days} * 50)$ .

8. The moving cost formula for 2000 lbs going to Newport (from Pensacola) is:  $co. = (2000 * (\text{Personal Property Accessorial Services Pamphlet designated charge for moving 2000lbs 1388 miles } (.4790)) + (\text{miles traveled} * .15) + (\text{authorized travel days} * 50))$ .
9. The moving cost formula for 600 lbs going to Newport (from Pensacola) is:  $cost = (600 * (\text{Personal Property Accessorial Services Pamphlet designated charge for moving 600lbs 1388 miles } (.7680)) + (\text{miles traveled} * .15) + (\text{authorized travel days} * 50))$ .
10. The average moving cost formula for 2000 lbs going to Newport is:  $cost = (2000 * (\text{Personal Property Accessorial Services Pamphlet designated charge for moving 2000 lbs 1239.45 miles } (.444)) + (\text{miles traveled} * .15) + (\text{authorized travel days} * 50))$ .
11. Ensigns were considered to be single.
12. All moves were assumed to be Do It Yourself (DITY) moves (ensigns move themselves and are paid 95% of what it would have cost the government).

## 5. Total Moving Expenses Due to Attrition

Despite the fact that flight school orders have recently changed, to provide a broader comparison, both policies associated with household goods will be analyzed. Table 4.18 depicts a time-valued approximation of how much was spent moving disqualified aviation candidates to Pensacola, then onto Newport. This table reflects ensigns moving all of their household goods (2,000 lbs was used as an average); Table 4.19 provides a detailed listing of these costs. The amounts presented in Tables 4.18 and 4.19 are excess costs the Navy actually incurred because of disparities between flight physicals (flight school orders were changed in DEC 99). Note, the cost of storing 1,400 pounds is not included in the figures, and the amounts shown reflect DITY moves. Tables 4.20 and 4.21 display excess moving costs that would have resulted if the 600 lb moving limitation had been implemented in 1995.

	1995	1996	1997	1998	1999	Total
FV	\$63,108.89	\$41,286.19	\$46,853.49	\$25,757.83	\$24,072.74	\$201,079.13

**Table 4.18 Alternative Three's Time-Valued Costs (Moving 2,000 lbs)**

2000 lbs	Year	NPQ No Waiver Candidates	Cost of Moving 2000 lbs to Pensacola, FL	Cost of Moving 2000 lbs to Newport, RI	Total Moving Cost Resulting From Attrition
	1995	20	\$21,779.47	\$26,366.00	\$48,145.47
	1996	14	\$15,245.63	\$18,456.20	\$33,701.83
	1997	17	\$18,512.55	\$22,411.10	\$40,923.65
	1998	10	\$10,889.74	\$13,183.00	\$24,072.74
	1999	10	\$10,889.74	\$13,183.00	\$24,072.74
Average Cost of Moving a Candidate to Pensacola	\$1,088.97				
Cost of Moving a Candidate from Pensacola to Newport	\$1,318.3				

**Table 4.19 Moving Costs Resulting From Attrition (2,000 lbs)**

	1995	1996	1997	1998	1999	Total
<b>FV</b>	\$40,801.37	\$26,692.49	\$30,291.87	\$16,653.04	\$15,563.59	\$130,002.35

**Table 4.20 Alternative Three's Time-Valued Costs (Moving 600 lbs)**

600 lbs	Year	NPQ No Waiver Candidates	Cost of Moving 600 lbs to Pensacola, FL	Cost of Moving 600 lbs to Newport, RI	Total Moving Cost Resulting From Attrition
	1995	20	\$14,207.97	\$16,919.20	\$31,127.17
	1996	14	\$ 9,945.58	\$11,843.44	\$21,789.02
	1997	17	\$12,076.77	\$14,381.32	\$26,458.09
	1998	10	\$ 7,103.99	\$ 8,459.60	\$15,563.59
	1999	10	\$ 7,103.99	\$ 8,459.60	\$15,563.59
Average Cost of Moving a Candidate to Pensacola	\$710.40				
Cost of Moving a Candidate from Pensacola to Newport	\$845.96				

**Table 4.21 Moving Costs Resulting From Attrition (600 lbs)**

## 6. Potential Savings

Table 4.22 shows what the average cost of moving disqualified aviation candidates directly to Newport, RI for Surface Warfare Officers School would have been

(because this school is longer than twenty weeks, ensigns are allowed to move all of their household goods). Table 4.23 provides the time-valued total.

2,000 lbs	Year	NPQ No Waiver Candidates	Total Moving Cost
	1995	20	\$24,590.35
	1996	14	\$17,213.25
	1997	17	\$20,901.80
	1998	10	\$12,295.18
	1999	10	\$12,295.18
Average Cost of Moving to Newport / Candidate	\$1,229.52		

**Table 4.22 Average Cost of Moving 2,000 lbs to Newport**

	1995	1996	1997	1998	1999	Total
<b>FV</b>	\$32,232.93	\$21,086.97	\$23,930.47	\$13,155.84	\$12,295.18	\$102,701.38

**Table 4.23 Time-Valued Cost of Moving NPQ Candidates Directly to Newport**

If the pre-commissioning physical were more accurate, NOMI wouldn't disqualify as many individuals; instead these people would be sent for training into another warfare community (this thesis assumes the surface Navy)—driving down moving costs. The formula to determine what these savings would have been is: savings = (average cost of moving NPQ candidates to Pensacola) + (cost of moving NPQ individuals from Pensacola to Newport) – (average cost of moving NPQ candidates directly to Newport). Doing this, with ensigns moving all of their household goods, results in a time-valued savings of \$201,079.13 - \$102,701.38 = \$98,377.75. Because it is not determinable if the health of candidates legitimately deteriorated between physicals, this savings represents an upper bound. It should also be recognized that this savings does not reflect costs associated with ensigns' salaries and benefits while they

move to Pensacola and later to Newport. These expenses are additional costs of maintaining the current system and were beyond the scope of this thesis to quantify.

## **G. SENSITIVITY ANALYSIS**

### **1. Description**

The basic purpose of a sensitivity analysis is to acknowledge underlying uncertainty—and predict how sensitive net benefits are to changes in assumptions. In essence, it gives an upper and lower bound of the effects various variables have on the study's net outcome. According to OMB Circular A-94, major assumptions should be varied and net present value and other outcomes recomputed to determine how sensitive outcomes are to changes in the assumptions. The assumptions that deserve the most attention depend on dominant benefit and cost elements and the areas of greatest uncertainty of the program being analyzed.

### **2. Analysis**

The strongest assumptions made by this study deal with costs linked to air travel, and driving aviation candidates to their pre-commissioning flight physicals. These assumptions do not influence alternative three; however, they greatly affect alternatives one and two—subjecting them to sensitivity analysis.

It has been assumed that the price of an airline ticket, regardless of departure or arrival destination, was \$400. At this price, the time-valued costs of restructuring the pre-commissioning flight physical and sending all candidates to the ACES program were determined to be \$399,885.56 and \$1,823,346.38, respectively. Table 4.24 demonstrates both alternatives' costs assuming the price of an airline ticket is lowered to \$300.

As evidenced by Table 4.24, alternative one isn't overly sensitive to changing airfare rates (a 25% drop in airfare only decreased total costs by 2.81%). Decreasing airline ticket prices does, however, have a strong affect on costs associated with opening the ACES program to all NROTC candidates; here, a 25% drop in airfare produces a 9.91% savings.

	1995	1996	1997	1998	1999	Total
<b>Alt. One</b>	\$128,238.58	\$65,463.00	\$71,675.66	\$55,923.40	\$67,359.89	\$388,660.53
<b>Alt. Two</b>	\$536,566.72	\$318,458.35	\$263,091.51	\$263,338.80	\$261,136.27	\$1,642,591.65

**Table 4.24 Time-Valued Costs Assuming a \$300 Airline Ticket**

The next assumption requiring further attention deals with how aviation candidates travel to their pre-commissioning flight physicals (and the ACES program). One hundred percent of the TAD reimbursable amount was charged to every student driving to a flight physical. This is a very strong assumption; in reality, many students ride to their physical together in a governmental vehicle.

Table 4.25 demonstrates what happens when only a third of the individuals, for whatever reason, drive alone to the pre-commissioning physical (the cost figures include the \$400 airline ticket charge). Alternative one, restructuring the pre-commissioning flight physical, is extremely sensitive to this assumption; reducing the overall TAD reimbursable charge by two-thirds resulted in a 31.26% cost reduction. Alternative two's costs, on the other hand, were only reduced by 2.40%.

	1995	1996	1997	1998	1999	Total
<b>Alt. One</b>	\$90,594.62	\$42,461.05	\$53,227.42	\$38,658.90	\$49,944.85	\$274,886.84
<b>Alt. Two</b>	\$584,118.57	\$344,057.92	\$287,220.56	\$281,461.03	\$282,760.32	\$1,779,618.40

**Table 4.25 Time-Valued Costs Assuming a 2/3 Reduction in TAD Reimbursable Rates**

Table 4.26 shows the results of relaxing both assumptions for both alternatives.

	1995	1996	1997	1998	1999	Total
<b>Alt. One</b>	\$87,055.47	\$40,868.49	\$51,281.09	\$36,411.90	\$48,044.85	\$263,661.81
<b>Alt. Two</b>	\$523,821.95	\$309,266.70	\$257,338.67	\$254,176.03	\$254,260.32	\$1,598,863.67

**Table 4.26 Time-Valued Costs Assuming a \$300 Airline Ticket and 2/3 TAD Charges**

## **H. SUMMARY**

Chapter IV analyzed two alternatives to the current flight physical screening process. Recognizing historic physical attrition rates, it calculated the approximate time-valued costs of these alternatives; actual attrition costs, reflecting the current screening process, were also calculated. Then, a sensitivity analysis determined the impacts of varying the strongest modeling assumptions used: airline ticket prices and van pool transportation.

No attempt was made in this chapter to value the potential benefits of implementing alternatives one or two; this analysis can be found in Chapter V.



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## **V. CONCLUSION AND RECOMMENDATIONS**

### **A. CONCLUSION**

This thesis provides a critical assessment of the Naval Reserve Officer Training Corps (NROTC) flight physical screening process. This assessment includes: an explanation of the Naval Operational Medical Institute's (NOMI) roles and responsibilities, a detailed description of the NROTC aviation screening process, quantification and analysis of flight physical attrition rates, and a cost-benefit analysis of alternative means to screen NROTC potential aviators. Perhaps the most beneficial aspect of this study, taking into account all assumptions made, was that it used the derived attrition information to establish the approximate cost of the current screening system, as well as two selected alternatives.

It was determined that from 1995 to 1999, 9.98% of NROTC aviation candidates passed their pre-commissioning flight physical but failed the follow on NOMI physical (using NOMI's data); this percentage is 8.03% using CNET's figures. Recognizing waivers granted for disqualifying conditions, the overall percentage of candidates not actually allowed to fly was 4.76% and 3.83%, respectively.

With the goal of lowering this attrition, two alternative screening methods were analyzed: restructuring the NROTC pre-commissioning flight physical and sending all NROTC aviation candidates to the Aviation Certification Evaluation and Screening (ACES) program. Optimization software was used to determine the most advantageous pre-commissioning flight physical sites for all NROTC units. The recommended solution restructured the pre-commissioning physical to use only seventeen facilities, and resulted in a projected time-valued variable cost of \$399,885.56 (for 1995 to 1999). Sending all

NROTC aviation candidates to Pensacola for their pre-commissioning flight physicals (and the ACES program) was the most expensive alternative; it produced a total estimated cost of \$1,823,346.38. Lastly, because of changes in orders to flight school, the cost of the current screening was computed two ways: with ensigns moving 2,000 and 600 lbs to flight school. Either way, implementing zero change to the current process was, by far, the cheapest alternative. Ensigns moving 2,000 lbs resulted in a time-valued cost of \$201,079.13 (compared to a cost of \$102,701.38 if NPQ ensigns were moved directly to Newport); when only 600 lbs were moved, total costs fell to \$130,002.35.

The most difficult aspect of this thesis dealt with the subjectivity of its data. It could not be determined if the health of candidates found NPQ by NOMI legitimately deteriorated during the months between their flight physicals (this mainly applies to vision), where NPQ candidates were coming from, how much is currently spent on NROTC pre-commissioning flight physicals, and if proposed changes would reduce screening attrition rates. Because of these unknowns, it's difficult to compile a resounding conclusion; recommendations, however, can still be made.

## **B. RECOMMENDATIONS**

The results of this study, without careful interpretation, can be very misleading. Although maintaining the current examination structure appears to be the least expensive alternative, it most likely isn't. This option only considered consequential moving costs associated with candidates being found NPQ (without waiver) by NOMI; the actual cost of transporting candidates to the pre-commissioning physical is not included in the cost estimate. Also, it is quite possible that many NROTC units utilize private sector facilities to complete pre-commissioning flight physicals; doing this is most likely more expensive

than keeping 100% of the physicals in-house. To foster an equal comparison, the current structure's variable costs (along with private sector screening expenses) would need to be determined and added to the cost of moving disqualified candidates.

Not focusing solely on the cost issue, the negatives of continuing the current screening system seem to outweigh the positives. Sending away almost 4% (using best-case percentages) of ensigns reporting to flight school appears to leave room for improvement; sadly, this attrition has probably decreased the morale of these individuals—hindering their dedication and loyalty to the Navy. Along with this frustration, although not examined by this thesis, the salaries of the transitioning officers should also be considered an expense (they are contributing absolutely nothing to the organization). The question becomes: how much is it worth to better the attrition situation?

Ignoring costs completely, without a doubt, the best way for the Navy to screen potential aviators is to send them through the ACES program. Here, NOMI personnel give an extremely accurate flight physical and candidates have the opportunity to experience flight school's demands first hand. ACES, in theory, should lower the screening process's attrition, as well as the number of Student Naval Aviators (SNA) that drop / fail out of flight school. But, when the vast resources the ACES program requires are taken into account, its potential benefits prove very expensive.

So, if the cost of opening the ACES program to all NROTC aviation candidates can't be justified, the next best alternative (analyzed by this thesis) is to restructure the pre-commissioning physical. Reducing the number of sites performing these physicals would make standardization, conformity, and tracking techniques much easier for NOMI

to control. The new screening structure would not be as comprehensive of an evaluation as the ACES program; however, it's roughly 80% cheaper, and in theory, should also increase the accuracy of the pre-commissioning physical—lowering the flight physical attrition rate. Accompanied by the restructuring, perhaps to help reduce SNA attrition, a realistic—intimidating—flight school video / documentary could be produced. This film could be shown to NROTC individuals wanting to fly, giving them the 'real deal' on flight school. This may discourage less ambitious or highly apprehensive candidates from even applying to flight school—helping to better the SNA attrition rate.

### **C. RECOMMENDATIONS FOR FURTHER STUDY**

As mentioned in this conclusion, it would be extremely beneficial to know how much is actually spent on the current NROTC aviation screening process. Secondly, another alternative worthy of analyzing would be to establish a regional structure for the ACES program. To alleviate resource constraints on NAS Pensacola's facilities, and to lower overall distances traveled, several Naval facilities having physiological training capabilities (i.e. NAS Pax River, NAS Whidbey Island) could also be used for the ACES screening. As in alternative one (changing the structure of the pre-commissioning physical), optimization techniques could determine the assignment matrix that would result in the lowest overall cost. There are two problems foreseeable with this alternative that would require further consideration, however: getting candidates a flight in the T-34, and making sure the pre-commissioning flight physical is done to NOMI's exact specifications / level of quality.

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